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How do we assess “sustainability” with proper indicators?

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Assessment of sustainability of technologies is a challenge. Social and economic sustainability are both largely influenced by culture perspective and local conditions. Therefore, the approaches for their assessment are diverse and there is no clear understanding of what the critical elements are ¹. In comparison, environmental sustainability is more scientifically robust, but there is also very little consensus on the assessment. The aim of the study is to identify and compare relevant environmental sustainability assessment indicators across different domains of application, within the context of supporting decision making around choice and development of technologies. We reviewed some mainstream realms that have been under development in the past few decades, aiming at achieving sustainability. The realms that will be presented in this study include Life Cycle Assessment (LCA), planetary boundaries (PB) and broader regulatory contexts (e.g. Sustainable Development Goals (SDGs), Environmental Performance Index (EPI, Hsu et al., 2013) and OECD indicators ³).

Essential aspects to consider for sustainability indicator sets, include what is the protected system, time scale and system quality that needs to be maintained. Generally speaking, LCA and PB have similar purposes. They aim at protecting ecosystems, and the considered time scales depend on the impact category. However, for LCA there is no clear indication of the system quality that will be maintained, while PB tries to retain the ecosystem in the zone that is safely operatable for humanity. In comparison, the regulatory context environmental sustainability indicators are more human centered. The time scale is always within certain years for political reasons (e.g. until 2030 for SDGs). Similar to LCA, the system quality that will be maintained is not clearly stated.

A widely used flexible framework for relating human activities to environmental status is Driver-Pressure-State-Impact-Response (DPSIR) scheme. In general, LCA and planetary boundaries mainly include states indicators. SDGs put more focus on pressure indicators. OECD and EPI provide both pressure and states indicators. Comparably, SDGs and OECD cover the most impact categories, while EPI covers the least. There are some common impact categories that are covered by at least 3 out of 5 mentioned indicator sets, including climate change, acidification, ozone depletion, eutrophication, air pollution, chemical pollution, freshwater use and forest resources. We noticed that indicators under some impact categories are still under development, including noise, accident, land system change, marine system change, fish resources, fossil resources and mineral resources depletion.

When assessing sustainability of a technology, it is essential to choose indicators properly towards the goal, considering the criteria mentioned above, e.g. protected system, time scale, system quality to be maintained, and the proper position in the DPSIR scheme.

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2. Hsu, A., Johnson, L. & Lloyd, A. *Measuring progress: A practical guide from the developers of the Environmental Performance Index (EPI)*. (2013).

3. OECD. *Indicators to measure decoupling of environmental pressure from economic growth*. 1–3 (2002).